Multimodal Transportation Design in Davis

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1 Background

It is assumed that there are 60000 commuters in Davis, half of which are students and the other half are employees, these two groups are supposed to have no overlap for convenience, even though many of the students are employees as well. The typical student hour(the average time students spend at school) is set as 3 hours, which determines the frequency of trip generation. Another stringent assumption is that there is no public transportation available now in Davis and the conditions of bike path are bad. Thus there are only mobility alternatives: Riding a Bike and Driving a Car, table 1 shows the travel summary of the base case,

Table 1 Travel Summary Before Improvement

	To Campus	From Campus	Distance (mi)	Average (mi)
Bike	6216	6216	32678.6	5.3
Drive	67965	67965	421949.2	6.2
Total	74181	74181	454627.8	6.1

There are 74181 trips generated from campus and to campus every day, and 91.6 % of them are taken by car. Since there is no parking fee and current roads are not friendly to bicyclists, people tend to drive more than a situation where public transportation services are available. Table 2 shows these trips generate 161.4 g/mile CO_2, and this value equals the per passenger mile generation value, indicating no carpooling cases are considered.

Table 2 Fuel Consumption and Emission Before Improvement

Mode	Distance	Fuel (kg)	Elec kWh	Total CO_2(kg)	Total HC(kg)	Total CO(kg)	Total NOx(kg)	Total PM(kg)	CO_2 g/mi	HC g/mi	CO g/mi	NOx g/mi	PM g/mi	CO_2 g/pmi	HC g/pmi	CO g/pmi	NOx g/pmi	PM g/pmi
Bike	32678.6	0.0	0.0	1104.4	0.0	0.0	0.0	0.00	33.8	0.0	0.0	0.0	0.00	33.8	0.00	0.00	0.00	0.000
Employee	187660.2	6762.3	-1865.1	28963.2	61.2	1146.2	219.6	0.00	154.3	0.3	6.1	1.2	0.00	154.3	0.33	6.11	1.17	0.000
Student	234289.1	9831.0	0.0	43318.1	164.4	3006.8	906.5	0.00	184.9	0.7	12.8	3.9	0.00	184.9	0.70	12.83	3.87	0.000
Total	454627.8	16593.3	-1865.1	73385.7	225.5	4153.0	1126.1	0.00	161.4	0.5	9.1	2.5	0.00	161.4	0.50	9.14	2.48	0.000

To reduce average Green House Gas(GHG) emission and tailpipe pollutants per passenger mile travelled, multimodal transportation including driving, bus and bicycling is proposed, there are three methods to encourage people to take sustainable models: 1) developing the Davis public transportation system, 2) Building more accessible bike path, 3) Charging parking fees.
LEV III standard is used as a benchmark to evaluate the performance and ULEV 125 is targeted for light duty vehicles.

2 Development of Public Transportation

2.1 Bus Station Selection

In the base case without improvement, we can get a trip Origin-Destination(OD) map, which is shown on Figure 1 and Figure 2

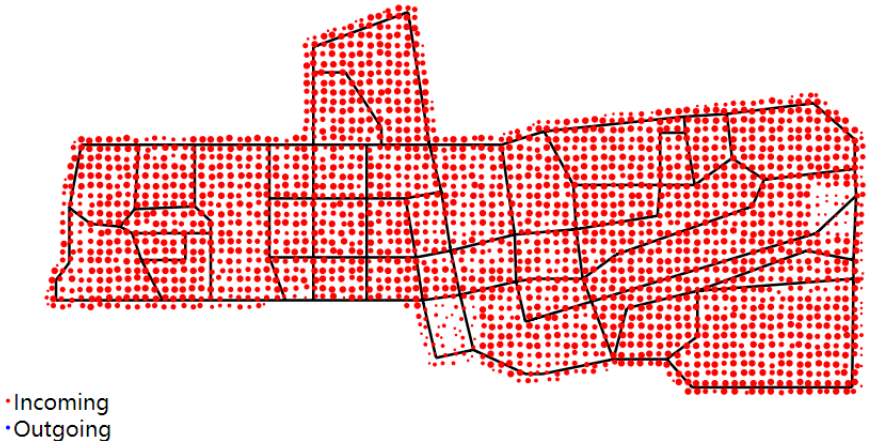


Figure 1 Trip Origin Map on Morning Peak Hour

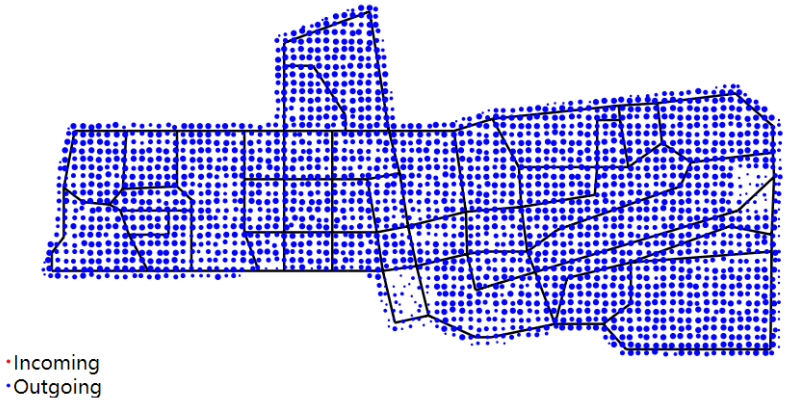


Figure 2 Trip Destination Map on After-school Peak Hour

OD maps demonstrate a uniform spatial distribution of trip generation, thus we should take the accessibility for all commuters into consideration when choosing sites for bus stations. Ideally, the recommended walking time for commuters to the nearest bus station is within 5 minutes. Furthermore, with the large amounts of pedestrians and road designs in downtown area, few bus stations will be built there. Based on these considerations, 51 stations are sited as shown in Figure 3.

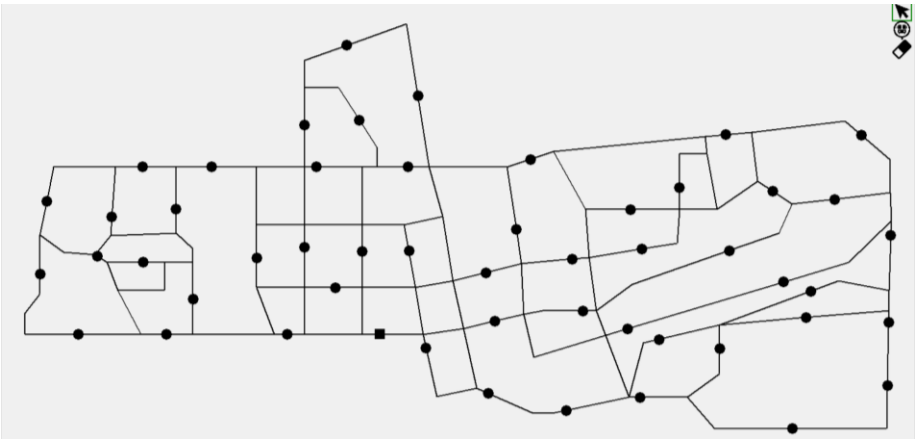


Figure 3 Bus Station Map

2.2 Bus Routes and Timing Design

More bus routes means there are more alternatives and flexibility when we make a trip to or from campus, while too many routes would increase the burden of operation, which calls for more financial investment and more drivers to run the circle. Meanwhile, though more departure frequency means the high possibility commuters catch the ride, over-frequent bus timing would result in a low carrier rate of that route, then passenger average emission will increase. Thus, it is necessary to make a balance between the lanes of bus routes and the departure frequency. A manual adjustment method is natively proposed here.

Table 3 Bus Departure Statistics of 5 Routes on 9AM

R1	Buses	Campus	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	Campus
Loop 5 (09:00)	3	27	36	45	49	62	85	85	94	106	107	126	159	169	171	188	191	191
Loop 6 (09:30)	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1

R2	Buses	Campus	S16	S17	S3	S18	S19	S6	S20	S21	S9	S22	S13	Campus
Loop 5 (09:10)	3	12	24	47	57	75	112	118	143	164	177	183	191	191
Loop 6 (09:40)	1	1	2	2	2	4	8	8	8	7	7	9	9	9

R3	Buses	Campus	S17	S23	S20	S21	S9	S24	S25	S26	S27	Campus
Loop 5 (09:00)	3	16	32	70	81	95	103	120	136	154	191	191
Loop 6 (09:30)	1	1	1	1	1	1	1	1	1	1	1	1

R4	Buses	Campus	S27	S26	S28	S29	S30	S31	S32	S33	S15	S34	Campus
Loop 5 (09:10)	2	47	33	32	40	32	25	44	74	91	89	98	98
Loop 6 (09:40)	1	1	1	1	1	1	1	1	1	1	1	1	1

R5	Buses	Campus	S12	S13	S29	S30	S35	S36	S39	S37	S15	Campus
Loop 7 (09:00)	1	4	4	4	3	3	3	3	4	4	4	4
Loop 8 (09:20)	2	40	40	35	63	82	94	107	119	151	155	155

First, four routes are placed with a half-a-hour frequency(R1-4), one route has a 20-minute frequency. Allowed maximum amount of bus in a loop is set as 3. however, the bus departure tables between 9AM to 10AM tells there exists a nearly no-load situation in one of the two loops, then the frequencies are adjusted to 1 loop/hr.

Table 4 Bus Arrival Statistics of 5 Routes on 7AM

R1	Buses	Campus	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	Campus
Loop 1 (07:00)	3	0	2	15	18	38	58	64	94	114	118	136	150	164	171	187	191	191

R2	Buses	Campus	S16	S17	S3	S18	S19	S6	S20	S21	S9	S22	S13	Campus
Loop 1 (07:10)	3	0	7	22	34	54	85	95	131	166	180	184	191	191

R3	Buses	Campus	S17	S23	S20	S21	S9	S24	S25	S26	S27	Campus
Loop 1 (07:00)	3	0	12	45	72	100	102	121	142	173	191	191

R4	Buses	Campus	S27	S26	S28	S29	S30	S31	S32	S33	S15	S34	Campus
Loop 1 (07:10)	3	0	24	49	77	79	85	111	149	175	179	191	191

R5	Buses	Campus	S12	S13	S29	S30	S35	S36	S39	S37	S15	Campus
Loop 1 (07:00)	3	0	24	54	69	85	103	124	139	179	191	191
Loop 2 (07:20)	3	0	8	22	44	68	94	132	165	189	191	191

While when inspecting the arrival statistics during morning peak hours, we find all 3 buses are employed and each one reaches the maximum load, suggesting higher frequency or more buses in a loop is needed.

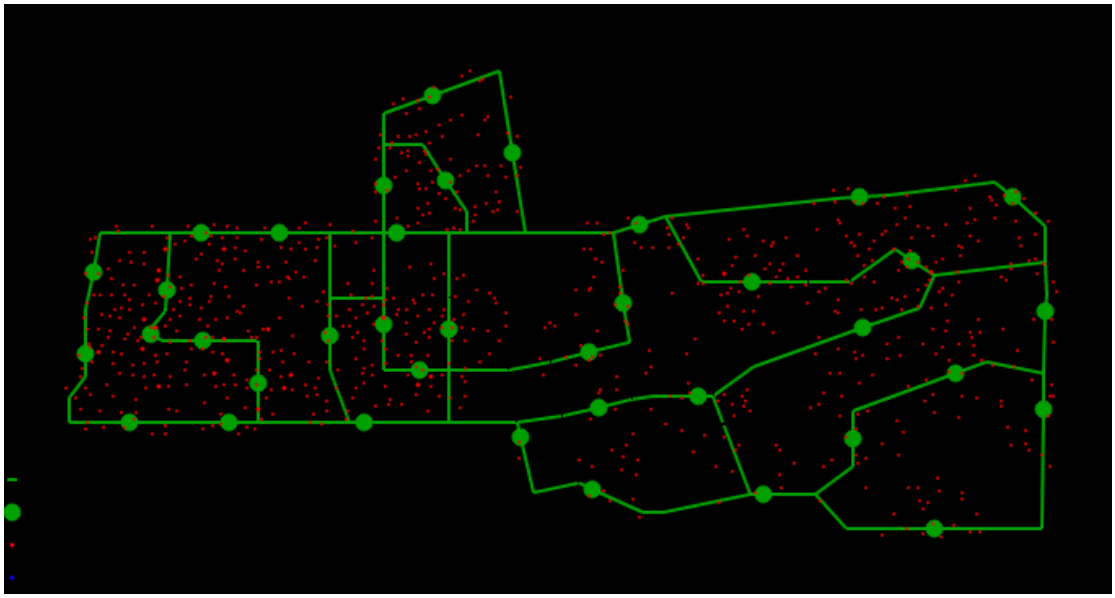


Figure 4 Bus Trip Generation Map on 7AM with 5 Routes

Figure 4 shows a spatial distribution inhomogeneity of bus trip generation during morning peak hours, the east areas in Davis have a more sparse distribution, mostly because there are only 2 lines passing there and the low departure frequency can't handle the high travel demands. Thus a new route mainly operated between stations in east Davis and the campus is built. To make sure the public transportation can load more passengers during morning and after-school peak hours, the departure frequencies of all 6 lines are adjusted to 20-minute during these time and the allowed maximum amount of bus in a loop is changed to 8.

Figure 5 Bus Trip Generation Map on 7AM with 6 Routes

After improvement, which is shown in Figure 5, there are more commuters choosing public transportation than the situation where only 5 routes with uniform 1-hour frequencies are operated.

3 Design of Bike Paths

Known for its well-designed bike paths, Davis gets the fame of Capital of Bicycle in America. Without doubt, riding bikes is one of the most sustainable travel models, new shared mobility choices like Jump Bike and Ford Bike are even encouraging more people to run on cycles rather than wheels. To improve the accessibility and safety for bicyclists, more bike paths with good condition are needed. Considering the land use features and possibility to take multimodal mobility, new bike paths are built along existing urban roads with a total length of 67.07 miles.

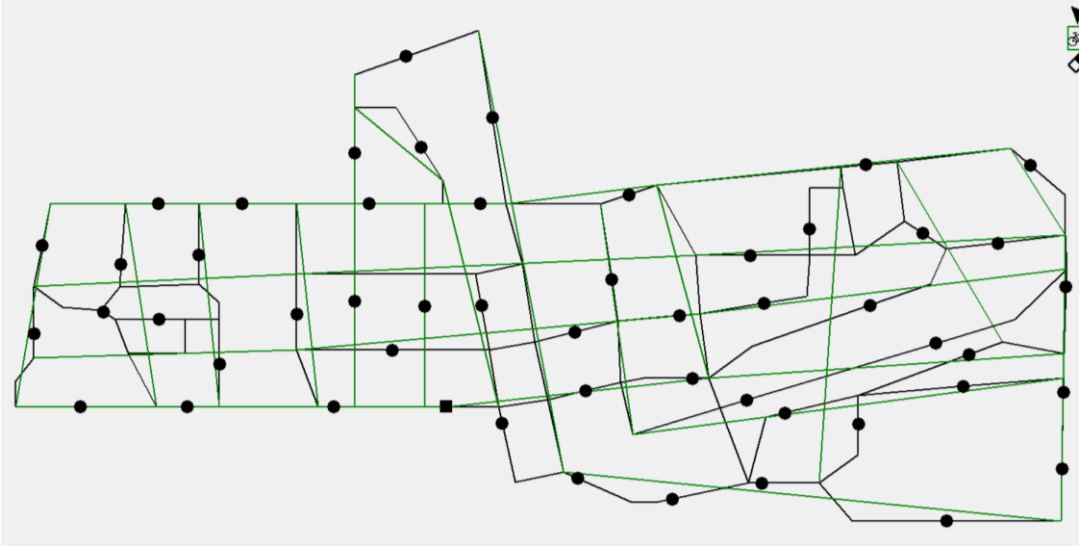


Figure 6 Bike Path Network

Figure 6 shows the network of new built bike paths, for I met a lot of problems when plotting the paths along the urban roads, straight lines are used to represent the actual curves of paths.

4 Pricing Strategy

To encourage more people to take sustainable travel models, like bicycling and public transportation, a pricing strategy combined with bus riding fee and parking charging is proposed. UC Davis now has a transportation pricing standard, $1.25 for bus riding, $9 a day without parking permit. And when taking bus from the campus, people don't need to pay the riding fee(and Great Free Rides), so the bus riding fee is set as $ 0.5 here for simulation. To force people to drive less but keep it in a reasonable range, parking fee is raised to $ 10 a day without permit. All these income will be used to offset the cost of building bike paths, purchasing buses, and operating the bus system(fuel consumption, drivers' wages, infrastructure maintenance)

5 Evaluation

Fuel consumption and emission table is used to evaluate the performance of the improved multimodal transportation system, which is listed in Table 5

Table 5 Fuel Consumption and Emission After Improvement

Mode	Distance	Fuel (kg)	Elec kWh	Total CO_2(kg)	Total HC(kg)	Total CO(kg)	Total NOx(kg)	Total PM(kg)	CO_2 g/mi	HC g/mi	CO g/mi	NOx g/mi	PM g/mi	CO_2 g/pmi	HC g/pmi	CO g/pmi	NOx g/pmi	PM g/pmi
Bike	162138.2	0.0	0.0	9724.2	0.0	0.0	0.0	0.00	60.0	0.0	0.0	0.0	0.00	60.0	0.00	0.00	0.00	0.000
Bus	6307.0	2646.9	0.0	9728.1	8599.1	90.7	5.1	0.38	1542.4	1363.4	14.4	0.8	0.06	87.9	77.69	0.82	0.05	0.003
Employee	92896.1	3249.7	-909.8	13912.4	28.7	544.8	104.2	0.00	149.8	0.3	5.9	1.1	0.00	149.8	0.31	5.86	1.12	0.000
Student	91633.3	3611.0	0.0	15911.2	58.8	1085.0	322.6	0.00	173.6	0.6	11.8	3.5	0.00	173.6	0.64	11.84	3.52	0.000
Total	457354.6	9507.6	-909.8	49275.9	8686.6	1720.6	432.0	0.38	139.6	24.6	4.9	1.2	0.00	107.7	18.99	3.76	0.94	0.001

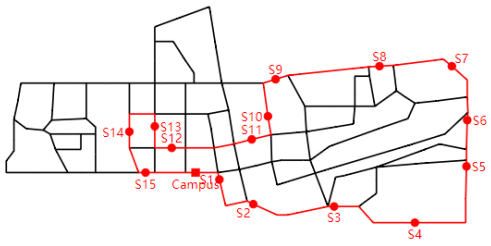
Compared with Table 1, CO_2 per passenger mile is reduced to 107.7g, with a 33.2% decrease. CO and NO_x per passenger mile have 37.2% and 37.75 respectively. However, HC per passenger mile increases by 147.5%.

Compared with ULEV 125 standard, NO_X per mile is 1.2g, 9.6 times the recommended value as 0.125g, CO per mile is 3.76g, 1.8 times the recommended value as 2.1g. HC per mile is 24.6g, 6.15 times the recommended value as 4g. PM per mile is 0.001, 10% of the recommended value as 0.01g.

6 Appendix

Bus Routes & Time Tables

Route: R1



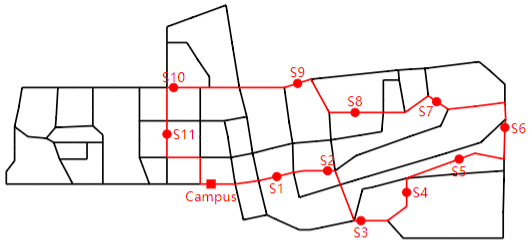
Bus Type:

Mark V

Times:

	Campus	S1 (S1)	S2 (S2)	S3 (S3)	S4 (S4)	S5 (S5)	S6 (S6)	S7 (S7)	S8 (S8)	S9 (S9)	S10 (S10)	S11 (S11)	S12 (S12)	S13 (S13)	S14 (S14)	S15 (S15)	Campus
Loop 1	06:20	06:21	06:24	06:28	06:32	06:37	06:40	06:43	06:47	06:52	06:55	06:57	07:01	07:03	07:06	07:09	07:12
Loop 2	06:40	06:41	06:44	06:48	06:52	06:57	07:00	07:03	07:07	07:12	07:15	07:17	07:21	07:23	07:26	07:29	07:32
Loop 3	07:00	07:01	07:04	07:08	07:12	07:17	07:20	07:23	07:27	07:32	07:35	07:37	07:41	07:43	07:46	07:49	07:52
Loop 4	08:00	08:01	08:04	08:08	08:12	08:17	08:20	08:23	08:27	08:32	08:35	08:37	08:41	08:43	08:46	08:49	08:52
Loop 5	09:00	09:01	09:04	09:08	09:12	09:17	09:20	09:23	09:27	09:32	09:35	09:37	09:41	09:43	09:46	09:49	09:52
Loop 6	10:00	10:01	10:04	10:08	10:12	10:17	10:20	10:23	10:27	10:32	10:35	10:37	10:41	10:43	10:46	10:49	10:52
Loop 7	11:00	11:01	11:04	11:08	11:12	11:17	11:20	11:23	11:27	11:32	11:35	11:37	11:41	11:43	11:46	11:49	11:52
Loop 8	12:00	12:01	12:04	12:08	12:12	12:17	12:20	12:23	12:27	12:32	12:35	12:37	12:41	12:43	12:46	12:49	12:52
Loop 9	13:00	13:01	13:04	13:08	13:12	13:17	13:20	13:23	13:27	13:32	13:35	13:37	13:41	13:43	13:46	13:49	13:52
Loop 10	14:00	14:01	14:04	14:08	14:12	14:17	14:20	14:23	14:27	14:32	14:35	14:37	14:41	14:43	14:46	14:49	14:52
Loop 11	15:00	15:01	15:04	15:08	15:12	15:17	15:20	15:23	15:27	15:32	15:35	15:37	15:41	15:43	15:46	15:49	15:52
Loop 12	16:00	16:01	16:04	16:08	16:12	16:17	16:20	16:23	16:27	16:32	16:35	16:37	16:41	16:43	16:46	16:49	16:52
Loop 13	17:00	17:01	17:04	17:08	17:12	17:17	17:20	17:23	17:27	17:32	17:35	17:37	17:41	17:43	17:46	17:49	17:52
Loop 14	17:20	17:21	17:24	17:28	17:32	17:37	17:40	17:43	17:47	17:52	17:55	17:57	18:01	18:03	18:06	18:09	18:12
Loop 15	17:40	17:41	17:44	17:48	17:52	17:57	18:00	18:03	18:07	18:12	18:15	18:17	18:21	18:23	18:26	18:29	18:32

Route: R2



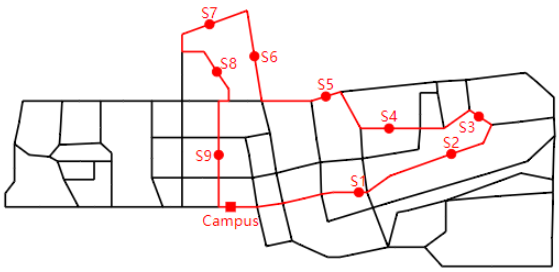
Bus Type:

Mark V

Times:

	Campus	S16 (S1)	S17 (S2)	S3 (S3)	S18 (S4)	S19 (S5)	S6 (S6)	S20 (S7)	S21 (S8)	S9 (S9)	S22 (S10)	S13 (S11)	Campus
Loop 1	06:30	06:33	06:35	06:39	06:42	06:45	06:49	06:54	06:58	07:02	07:08	07:11	07:15
Loop 2	06:50	06:53	06:55	06:59	07:02	07:05	07:09	07:14	07:18	07:22	07:28	07:31	07:35
Loop 3	07:10	07:13	07:15	07:19	07:22	07:25	07:29	07:34	07:38	07:42	07:48	07:51	07:55
Loop 4	07:40	07:43	07:45	07:49	07:52	07:55	07:59	08:04	08:08	08:12	08:18	08:21	08:25
Loop 5	08:10	08:13	08:15	08:19	08:22	08:25	08:29	08:34	08:38	08:42	08:48	08:51	08:55
Loop 6	09:10	09:13	09:15	09:19	09:22	09:25	09:29	09:34	09:38	09:42	09:48	09:51	09:55
Loop 7	10:10	10:13	10:15	10:19	10:22	10:25	10:29	10:34	10:38	10:42	10:48	10:51	10:55
Loop 8	11:10	11:13	11:15	11:19	11:22	11:25	11:29	11:34	11:38	11:42	11:48	11:51	11:55
Loop 9	12:10	12:13	12:15	12:19	12:22	12:25	12:29	12:34	12:38	12:42	12:48	12:51	12:55
Loop 10	13:10	13:13	13:15	13:19	13:22	13:25	13:29	13:34	13:38	13:42	13:48	13:51	13:55
Loop 11	14:10	14:13	14:15	14:19	14:22	14:25	14:29	14:34	14:38	14:42	14:48	14:51	14:55
Loop 12	15:10	15:13	15:15	15:19	15:22	15:25	15:29	15:34	15:38	15:42	15:48	15:51	15:55
Loop 13	16:10	16:13	16:15	16:19	16:22	16:25	16:29	16:34	16:38	16:42	16:48	16:51	16:55
Loop 14	17:10	17:13	17:15	17:19	17:22	17:25	17:29	17:34	17:38	17:42	17:48	17:51	17:55
Loop 15	17:30	17:33	17:35	17:39	17:42	17:45	17:49	17:54	17:58	18:02	18:08	18:11	18:15
Loop 16	17:50	17:53	17:55	17:59	18:02	18:05	18:09	18:14	18:18	18:22	18:28	18:31	18:35

Route: R3



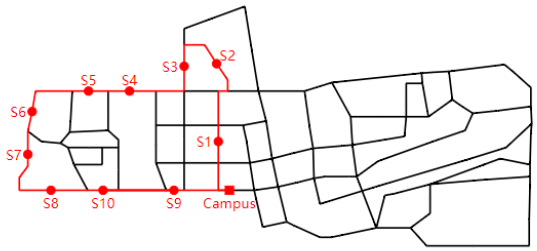
Bus Type:

Mark V

Times:

	Campus	S17 (S1)	S23 (S2)	S20 (S3)	S21 (S4)	S9 (S5)	S24 (S6)	S25 (S7)	S26 (S8)	S27 (S9)	Campus
Loop 1	06:20	06:25	06:29	06:32	06:37	06:41	06:45	06:49	06:53	06:57	07:00
Loop 2	06:40	06:45	06:49	06:52	06:57	07:01	07:05	07:09	07:13	07:17	07:20
Loop 3	07:00	07:05	07:09	07:12	07:17	07:21	07:25	07:29	07:33	07:37	07:40
Loop 4	08:00	08:05	08:09	08:12	08:17	08:21	08:25	08:29	08:33	08:37	08:40
Loop 5	09:00	09:05	09:09	09:12	09:17	09:21	09:25	09:29	09:33	09:37	09:40
Loop 6	10:00	10:05	10:09	10:12	10:17	10:21	10:25	10:29	10:33	10:37	10:40
Loop 7	11:00	11:05	11:09	11:12	11:17	11:21	11:25	11:29	11:33	11:37	11:40
Loop 8	12:00	12:05	12:09	12:12	12:17	12:21	12:25	12:29	12:33	12:37	12:40
Loop 9	13:00	13:05	13:09	13:12	13:17	13:21	13:25	13:29	13:33	13:37	13:40
Loop 10	14:00	14:05	14:09	14:12	14:17	14:21	14:25	14:29	14:33	14:37	14:40
Loop 11	15:00	15:05	15:09	15:12	15:17	15:21	15:25	15:29	15:33	15:37	15:40
Loop 12	16:00	16:05	16:09	16:12	16:17	16:21	16:25	16:29	16:33	16:37	16:40
Loop 13	17:00	17:05	17:09	17:12	17:17	17:21	17:25	17:29	17:33	17:37	17:40
Loop 14	17:20	17:25	17:29	17:32	17:37	17:41	17:45	17:49	17:53	17:57	18:00
Loop 15	17:40	17:45	17:49	17:52	17:57	18:01	18:05	18:09	18:13	18:17	18:20

Route: R4



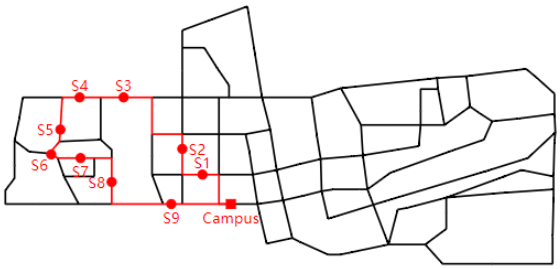
Bus Type:

Mark V

Times:

	Campus	S27 (S1)	S26 (S2)	S28 (S3)	S29 (S4)	S30 (S5)	S31 (S6)	S32 (S7)	S33 (S8)	S15 (S9)	S34 (S10)	Campus
Loop 1	06:30	06:33	06:37	06:40	06:44	06:46	06:49	06:51	06:54	07:00	07:04	07:10
Loop 2	06:50	06:53	06:57	07:00	07:04	07:06	07:09	07:11	07:14	07:20	07:24	07:30
Loop 3	07:10	07:13	07:17	07:20	07:24	07:26	07:29	07:31	07:34	07:40	07:44	07:50
Loop 4	08:10	08:13	08:17	08:20	08:24	08:26	08:29	08:31	08:34	08:40	08:44	08:50
Loop 5	09:10	09:13	09:17	09:20	09:24	09:26	09:29	09:31	09:34	09:40	09:44	09:50
Loop 6	10:10	10:13	10:17	10:20	10:24	10:26	10:29	10:31	10:34	10:40	10:44	10:50
Loop 7	11:10	11:13	11:17	11:20	11:24	11:26	11:29	11:31	11:34	11:40	11:44	11:50
Loop 8	12:10	12:13	12:17	12:20	12:24	12:26	12:29	12:31	12:34	12:40	12:44	12:50
Loop 9	13:10	13:13	13:17	13:20	13:24	13:26	13:29	13:31	13:34	13:40	13:44	13:50
Loop 10	14:10	14:13	14:17	14:20	14:24	14:26	14:29	14:31	14:34	14:40	14:44	14:50
Loop 11	15:10	15:13	15:17	15:20	15:24	15:26	15:29	15:31	15:34	15:40	15:44	15:50
Loop 12	16:10	16:13	16:17	16:20	16:24	16:26	16:29	16:31	16:34	16:40	16:44	16:50
Loop 13	17:00	17:03	17:07	17:10	17:14	17:16	17:19	17:21	17:24	17:30	17:34	17:40
Loop 14	17:20	17:23	17:27	17:30	17:34	17:36	17:39	17:41	17:44	17:50	17:54	18:00
Loop 15	17:40	17:43	17:47	17:50	17:54	17:56	17:59	18:01	18:04	18:10	18:14	18:20

Route: R5



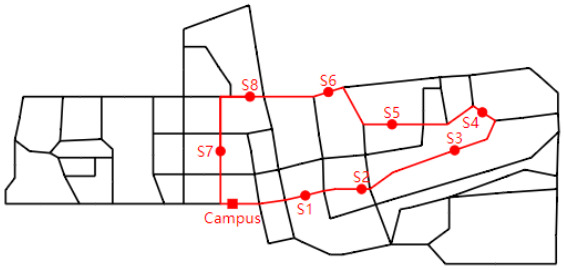
Bus Type:

Mark V

Times:

	Campus	S12 (S1)	S13 (S2)	S29 (S3)	S30 (S4)	S35 (S5)	S36 (S6)	S39 (S7)	S37 (S8)	S15 (S9)	Campus
Loop 1	06:40	06:42	06:44	06:49	06:51	06:54	06:56	06:57	07:00	07:03	07:06
Loop 2	07:00	07:02	07:04	07:09	07:11	07:14	07:16	07:17	07:20	07:23	07:26
Loop 3	08:00	08:02	08:04	08:09	08:11	08:14	08:16	08:17	08:20	08:23	08:26
Loop 4	09:00	09:02	09:04	09:09	09:11	09:14	09:16	09:17	09:20	09:23	09:26
Loop 5	10:00	10:02	10:04	10:09	10:11	10:14	10:16	10:17	10:20	10:23	10:26
Loop 6	11:00	11:02	11:04	11:09	11:11	11:14	11:16	11:17	11:20	11:23	11:26
Loop 7	12:00	12:02	12:04	12:09	12:11	12:14	12:16	12:17	12:20	12:23	12:26
Loop 8	13:00	13:02	13:04	13:09	13:11	13:14	13:16	13:17	13:20	13:23	13:26
Loop 9	14:00	14:02	14:04	14:09	14:11	14:14	14:16	14:17	14:20	14:23	14:26
Loop 10	15:00	15:02	15:04	15:09	15:11	15:14	15:16	15:17	15:20	15:23	15:26
Loop 11	16:00	16:02	16:04	16:09	16:11	16:14	16:16	16:17	16:20	16:23	16:26
Loop 12	17:00	17:02	17:04	17:09	17:11	17:14	17:16	17:17	17:20	17:23	17:26
Loop 13	17:20	17:22	17:24	17:29	17:31	17:34	17:36	17:37	17:40	17:43	17:46
Loop 14	17:40	17:42	17:44	17:49	17:51	17:54	17:56	17:57	18:00	18:03	18:06

Route: R6



Bus Type:

Mark V

Times:

	Campus	S16 (S1)	S17 (S2)	S23 (S3)	S20 (S4)	S21 (S5)	S9 (S6)	S27 (S7)	S43 (S8)	Campus
Loop 1	06:30	06:33	06:35	06:40	06:43	06:47	06:51	06:58	07:02	07:08
Loop 2	07:00	07:03	07:05	07:10	07:13	07:17	07:21	07:28	07:32	07:38
Loop 3	08:00	08:03	08:05	08:10	08:13	08:17	08:21	08:28	08:32	08:38
Loop 4	09:00	09:03	09:05	09:10	09:13	09:17	09:21	09:28	09:32	09:38
Loop 5	10:00	10:03	10:05	10:10	10:13	10:17	10:21	10:28	10:32	10:38
Loop 6	11:00	11:03	11:05	11:10	11:13	11:17	11:21	11:28	11:32	11:38
Loop 7	12:00	12:03	12:05	12:10	12:13	12:17	12:21	12:28	12:32	12:38
Loop 8	13:00	13:03	13:05	13:10	13:13	13:17	13:21	13:28	13:32	13:38
Loop 9	14:00	14:03	14:05	14:10	14:13	14:17	14:21	14:28	14:32	14:38
Loop 10	15:00	15:03	15:05	15:10	15:13	15:17	15:21	15:28	15:32	15:38
Loop 11	16:00	16:03	16:05	16:10	16:13	16:17	16:21	16:28	16:32	16:38
Loop 12	17:00	17:03	17:05	17:10	17:13	17:17	17:21	17:28	17:32	17:38
Loop 13	17:30	17:33	17:35	17:40	17:43	17:47	17:51	17:58	18:02	18:08